TITLE: OPTICAL MICROACTUATION IN PIEZOCERAMICS

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ABSTRACT:

Optically/electrically operable flexible film microactuators that can offer upto two orders higher efficiency of photonic to mechanical conversion compared to ceramic actuators are conceptualised. A polarized ceramic wafer of non-centrosymmetric perovskite ferroelectric AB03 compounds, such as lead lanthanum zirconate titanate (PLZT), when exposed to an illumination (-350 to 400 nm wavelength) close to the bandgap energy, can generate a large photovoltage (-1.0 kV/mm) across its length, and by the inverse piezoelectric effect causes the piezoceramic wafer to deflect in the direction away from the illumination. The optical actuation effect in piezoceramic wafers is investigated as a function of thickness, composition, and surface roughness. Such flexible microactuators would enable a new generation of micro-electro-mechanical and micro-opto-mechanical systems where the actuation will not be restricted by the clamping effect due to the rigid substrate as in the current silicon based micromachined structures. To deposit the piezoceramic film directly onto a flexible substrate, the substrate must have high temperature stability, high strength (Young's Modulus ~ 4.9x1 010 N/m2), a close match of thermal coefficients of expansion with the piezoceramic film, and a tailorable crystal orientation in order to provide a desired template for growth of oriented PLZT. This paper will present a comparison of a variety of flexible substrate films and fibers and our recent results on polybenzoxazole (PBO), a polymeric candidate

for a flexible high temperature substrate. Variation of the properties of PBO as a function of temperature will be presented.